DOCUMENT RESUME

ED 451 038 SE 064 572

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TITLE	Technical Education of Engineers in the Context of Multimedia Computer Technologies.
PUB DATE	1998-08-00
NOTE	7p.; Paper presented at the International Conference on Engineering Education (Rio de Janeiro, Brazil, August 17-20, 1998).
PUB TYPE	Opinion Papers (120) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Active Learning; *Audiovisual Instruction; Computer Uses in Education; *Engineering Education; Foreign Countries; Higher Education; *Learning Processes; Multimedia Materials; Visual Learning
IDENTIFIERS	Czech Republic

ABSTRACT

Modern means that can be used in the framework of teaching substantially extend the possibilities of schoolmasters, but they also complicate the pedagogical process. Can we make really effective use of them? Have we, at their application, really greater pedagogical effect? How do we include the possibilities of audiovisual techniques into the pedagogical process as suitably as possible? These are the questions that are reflected upon as we search for the answer. Use of the expression "search" is correct because it is the question of long-term, permanent processes and not all we have been able to try. Some procedures have proved successful while some had to be eliminated because too much work had to be invested in their preparation. We want to consult on this problem with other schoolmasters; we want to discuss their experience and think over the position and function of the schoolmaster in the future period when we all will be over-saturated with great amounts of information from various sources. (Author/YDS)

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ED 451 038

Technical Education of Engineers in the Context of Multimedia Computer Technologies

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Abstract *- Modern means that we can use in the framework of teaching extend substantially the possibilities of schoolmasters. They extend the possibilities but also complicate the pedagogical process. Can we make really an effective use of them ? Have we - at their application really greater pedagogical effect ? How to include the possibilities of audiovisual technics into pedagogical process as suitably as possible ? These are the questions that the authors think over and on that they search the answer. Using of the expression „search" is correct because it is the question of long-term, permanent process and not all we have been able to try. Some procedures have been proved successfully some of them we had to eliminate because of too much work to be invested in their preparation. This is the main reason for elaborating of this paper. We want to consult this problem with other schoolmasters, we want to discuss their experience and think over the position and function of schoolmaster in the future period when we all will be over-saturated with great amount of information from various sources.*

Introduction

Just in the introduction we would like to think over the important question. Is it true that more information means more knowledge ? We have imaginations concerning the brain capacity or, better said, how much information can the brain take in during a day ? Don' t we over-saturate the student with too much information in such way that the resulting effect is lower than the student could gain with „optimal" information amount that will be permanently saved in the brain. It is natural that each individual is an other one and, that' s why, we take into account some imaginary average, i.e. the capabilities of approximately 66% students of the 1st course of the university. In the last year of the study only the average and better students remain.

Before we will start with further considerations concerning the knowledge we would like to call the attention the term information. The quantity and quality of information received depend, in our opinion, always on individual - receiver characteristics. Each of us receives the signals from the environs only with our own senses and from these signals everybody creates the information. It is the important view from the viewpoint of pedagogical process. Students in the lecture-hall receive signals from schoolmaster and also fromenvirons and each of them creates individually in the brain the information from these signals. This information is

saved, in some cases permanently, in case that it does not come to its renewal it is weakening and the capability of its release becomes extinct in the brain. But this is the known fact that repeating is the wisdom' s mother.

As a matter of fact what means knowledge ? From the above mentioned it is evident that knowledge is the individual characteristic of each individual. How are they deposited in the brain ? The correct answer on this question we do not know but, in our opinion, it can be so that in the brain we create so called models for various situations solution and then, by transfer or distribution of received signals into models and by selection of suitable simulation with models [in a brain] we can judge that the signals received belong to certain model. In this way we identify all what we know. However, if we have the signals that do not suit to any model then we have to create a new one in the brain, and namely on the basis of „verifying - learning" of newly created model characteristics. From that we can make a deduction that to new model creation we have carry out some simulations and on the basis of results to adjust the model structure in such way so that in brain the „correct" model could arise, i.e. to verify our model. Each individual creates his own model of solved/studied problem and he has his own knowledge concerning the same situation. It is substantial, in our opinion, for pedagogical process evaluation.

How we mentioned above, we will judge the average student. This coordination, however, cannot be quantified as final one. In our opinion also the capabilities of majority of students are developing, i.e. during the study the student adopts the evaluation approaches of received signals and creating of internal models, i.e. his capabilities will be improved. It is certainly the experience of all schoolmasters that the students are growing ripe during the study.

What does it mean from our viewpoint that the student is good, capable, wise in certain branch ? The answer is not simple certainly. In our opinion the students, at the end of study, can be divided in several types:

Research ones - i.e. such ones who can suitably combine the research models functions in their brain, i.e. they can create judgments

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Developmental ones - i.e. such ones who can suitably make use of their knowledge but have smaller capabilities to communicate with the environs

Managing ones - i.e. such ones who can make use of their knowledge and can communicate with the environs very well

Now, let' s return to the possibilities of schoolmasters' action on students. Nearly basic question is the schoolmasters' function in the educational process. In the Czech Republic, still 10 years ago, the meaning occurred that educational programs can replace the pedagogic work. We do not agree with this opinion and I believe that all good schoolmasters are not replaceable. Only schoolmaster, and namely and experienced one, who many times repeats the same matter and penetrates still deeper in given problem can guide the student and explain the connections that cannot be and never will be inserted into textbooks and materials. Nevertheless, the educational programs will play the important role also in the future in the pedagogic process as we try to prove by this contribution.

Knowledge gaining - learning

The learning object, certain part of educational matter has always two parts, and namely the recognized part and not recognized one [see Figure #1]. On learning beginning the recognized part is small and it is gradually increasing compared with the getting the not recognized one smaller. The basic question is the form of learning. By what can we improve the knowledge of the not recognized part ? In our opinion only by the active interference into object observed and by following the reaction to our interference, by an experiment with study object. Our opinion we can explain on basic management scheme [see Figure 2]. We judge e.g. the procedure of bicycling learning. A man follows the object behavior and he has an aim to go in certain direction and with a certain speed. According to the teacher' s instruction the learner interferes into object [he corrects the ride], he follows the reactions of the bicycle on certain interference and according to the interference education he gradually creates the model in his brain according to that he will further correct and control the ride under all situations. The controlled object must not be always a real one. Let' s take e.g. the theoretical airplane model created by the computer and controlling elements and information sources will be adjusted by execution to the real airplane. The learner gradually learns the real object model control in such way that he communicates with the stimulator as if he flied really. It depends only on simulator perfection how it can elucidate the real object to a student. He could learn flying even alone without any teacher, although in longer time period and due to the fact that he will not be „punished" for mistakes he does - he could not be so in case of real object without crash. With instructor - teacher he will manage this learning much earlier and, in addition, he learns better to forecast the situation that can occur. According to the Figure 2 the schoolmaster is that who gives the control goals.

Now we came to the simple scheme of correct and mainly effective learning. The schoolmaster gives the goal, he teaches the student to solve the situation and student - by the system of trials and mistakes - will create in his brain more or less perfect model of the process /object/theme. Final result of learning depends both on quality and capability of the teacher and on the quality and capability of student. Then, effective teaching process is - without schoolmaster' s presence - nearly not possible.

In the pedagogic process the teacher acts on student in accordance with the Figure 3, and namely by word, word and motion [actor' s expression], word - motion and picture or word - motion and model demonstration. By that, the model can be *real one* [teaching aid] or *abstract one*, i.e. demonstrated on computer or *hypothetical one* [linguistic one]. The picture could be created gradually in front of a learner by any suitable technique, e.g. on computer or on suitable projecting area with the printing of the whole picture. The picture should be, first of all, demonstrated at a time by projecting from a textbook or from computer memory, video etc. and gradually explained.
While the picture illustrates the structure of object being described, on the model we can present the object characteristics [static or dynamic ones]. In the course of the teaching, however, also the student acts on the teacher - in the sense of Figure 2 - see the Figure 3, and namely actively by a question, answers to the question or control of demonstrated model or by his behavior - he disturbs by his speaking. Generally - we can identify this pedagogic process with technical application - aids [computer, notebook, textbook etc.], in this first phase in simplified way [in accordance with Figure 4]. The schoolmaster acts on student and student acts on his aids [technique] and on the basis of this activity he acts back on teacher. There are two feedback control circuits, according to the Figure 2.

Teacher → student and student →aids.

Not all connections are, however, in the pedagogic process in the activity what is very known fact for all teachers - without exclusion. For instance - student does not write down anything but he only listens to teacher - what is possible and, in some case, even necessary. Sometimes, student writes down the notes [connection 10] and, in this time, pays not sufficient attention to teacher' s explanations. Better said, the student listens to teacher not actively, he does not evaluate the received signal in the brain, he does not close the learning feedback.

There are more possibilities of connections finding out in the teaching process but it has not been significant yet. There is significant that these two

circuits of learning process control should be divided - from the time point of view.

The 1st phase - the lecturer reads - the student listens to [connections 1 and 2, not only 1] *The 2nd phase* - the student makes use of the technique - he works individually [connections 10 and 20]. *The 3rd* phase - the student communicates with lecturer [connections 2 and 1]

The time period of single phases depends on read matter, on technical equipment [for the 2nd phase the computer technics plays the significant role], on lecturer' s experience and, what is significant as well, on student' s capabilities.

Using of pictures, schemes, formulas

Modern audiovisual technics brings to teachers the possibility of active using of all information forms - data, text, picture, sound - on preliminary prepared schemes, pictures sequences and relations. The pedagogic process is running then in accordance with Figure 5. The lecturer demonstrates the pictures, schemes, formula and, as a rule, he explain it [connection 1]. The student, in this case, listens to, and receives the displayed facts. While the motions and lecturer' s explanations activate the student' s attention and motivation, student devotes his effort to read matter understanding [picture + sound] and following perception saving into memory Some students save the received information into their memory as the picture, the other ones as the set of logically connected elements. The student, at such activity, does not connect [he must not connect] further functions of his body and does not gain and he cannot gain his own experience, i.e. connections 10 and 20 in the Figure 4 are not active.

We are convinced that effectiveness of such process is very small in case that the student' s activity is missing here. The improved pedagogic action will become when student, during lecturer' s explanations, will make the notes [see Figure 6]. The notes writing down to read matter is very active activity [according to the Figure 4 or 1]. The student - from the received explanations [signals] being saved in the brain selects the most important information elements - he creates the judgments individually - and this what he has selected he saves on note medium, i.e. he creates alone the schematic picture or writes down the text. It is not important if he writes down the notes on paper or into computer. At such activity the student loses relatively a lot of time when he cannot concentrate fully on the teacher' s explanation and the effectiveness of the teaching process is decreasing. The improvement of this situation is possible in case that the lecturer creates the picture or schemes in the course of his explanations and so the student has a time for his activity what has, however great demands on time. One of possibilities that has been examined by the authors as well is to provide the student preliminary prepared picture that is then completed together with the lecturer. This activity can be partially be simplified by textbooks into that the student writes down the notes but we have not any so far. It would be interesting, however, to create them and hand over our experience mutually on some of future conferences. The picture can be demonstrated by the lecturer also on computer and student, on his computer, will supplement the same picture or adjust according to the lecturer' s explanations.

Using of moveable pictures

Modern technics makes possible to use not only the static pictures but also time sequences of pictures - film about some event, nature, technical equipment, composing units from details or inversely. In such case the pedagogic action is the other one and the Figure 5 changes on Figure 6. The projecting equipment demonstrates automatically the time sequence of pictures, the projection is accompanied either by words from record or by the lecturer' s explanations. Both possibilities have no sense even it does not act pedagogically because it leads the student to neglecting of one voice perception and to no processing of this perception in his brain. The capability to perceive two sound signals at the same time has everyone but only excellent individuals have the capability to process both signals simultaneously and to save them into memory separately. We recommend the using of moveable video-records either with accompanying word or with the lecturer' s explanations but never at the same time. According to our opinion there is very purposeful:

- to have a look at the whole section with accompanying word from the record
- to return back to the beginning, to project one part of the record with the lecturer's accompanying word
- to explain the necessary parts with using of pictures, schemes and formulas
- pro project another part etc.

Using of models

The using of physical models or real objects is of great importance in the teaching process and especially in case when the student can experiment with given object. For example - stuffed animal gives the observer a good survey about the animal's looks. The possibility to observe the live animal for some time period let always permanent knowledge in the student' s memory. To learn - in geography - all about some distant country means contribution for the student but several-days stay as the supplement to earlier gained knowledge will establishes the knowledge about this country to such an extent that student can make use of it in the future.

The great importance for the teaching process has the work with objects and objects models. In this case the multimedia technics has the great priority compared with real objects, in relation to teaching process naturally. The authors emphasize the importance of real objects computer models because they cannot hidden their enthusiasm for models implementing

into the teaching process. We want again to render homage to modern multimedia technics [optical and acoustical perception together with the possibility of control] because it enables the control and operation of computer models also in such modes that would mean , in real situation, crash or e.g. countless damage, death or suffering of many people. However, by this we have digressed from this paper mission, and that' s why, let' s return back to pedagogical process. In the pedagogical process, in this case, 6 objects take part:

- schoolmaster [teacher, lecturer]
- student
- multimedia technics as the source of pictures, schemes, formulas, diagrams and texts as well
- object model with its static and dynamic characteristics and with the control possibilities
- aid [means] for student' s notes
- guide [manual] for work with model see Fig. 7.

In such case, e.g. in computer hall some possibilities arise at pedagogical process that alternate during the teaching process:

* P - S classic relation from Figure 2 when the teacher explains the matter
* P - S - Po classic relation from Figure 4 when the teacher explains the matter and the student writes down the notes
* P - MP - S the teacher makes use the possibilities of multimedia technics [MMT] during teaching process and the student writes down the notes
* P - MP and S - NP the teacher makes use the possibilities of multimedia technics [MMT] during teaching process and the student follows all on his computer
* P - MP and S - MP + Po the teacher makes use of possibilities of multimedia technics [MMT] and the student, in addition, writes down the notes
* S - MP - N the student works individually
* S - MP - N + P the student works individually under supervision [consultation] of the teacher

From this simple and partial survey of teacher' s work possible combinations we can see that the multimedia technics, videotechnics, modeling, simulation, virtual reality, CAD, CIM etc. bring into the pedagogical process the whole series of new possibilities that will be, in near future, still more perfect ones, and we have to prepare for it.

Conclusion

In the conclusions let' s look at pedagogical process from the other point of view. Will the students be in the future more capable than today? The teachers equipped with modern multimedia technics can shower them daily, in the course of 8 teaching hours, upon the huge information amount. But has it any importance? Will the student be capable to process such signal [information] amount? If we exceed the daily capacity of new information receiving then we must, aware of it and with full responsibility reduce the signals amount for student to such extent that they are capable to process in their brain effectively.
Let' s not forget, at making use of multimedia technics, that student can learn the most in their own active activity [connections 10 and 20 from Figure 4] what requires its time. This time we must let to students in the teaching process. So - in conclusion - less matter well trained is more effective than huge information amount not processed by the student. What is substantial and what we have to teach the students - the contents of engineering education, it will be the theme of separate section of future conferences.

References

[1] Dvorácek, J., Kebo, V. : Bilateral inter-connection of education of economics and application of computers in raw material industry. *Grant project MSMT CR*, #F1 528.

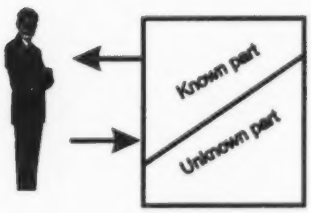


Fig.1 Relation between student end teacher

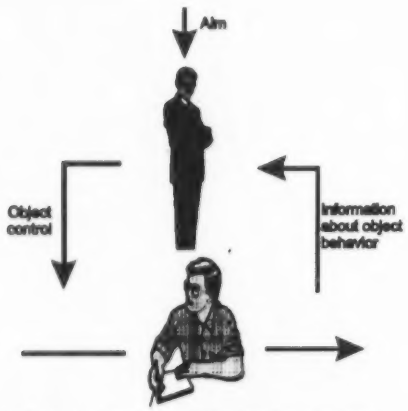


Fig.2 Learning as cybernetics process

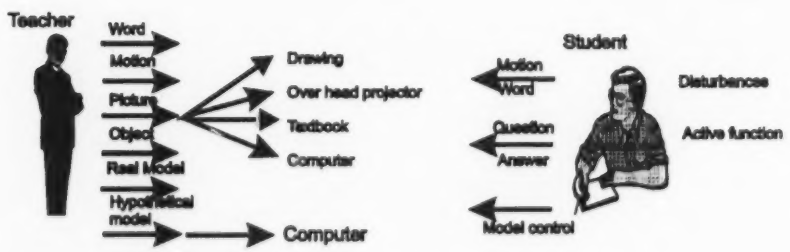


Fig.3 Means for interactions between teacher and student

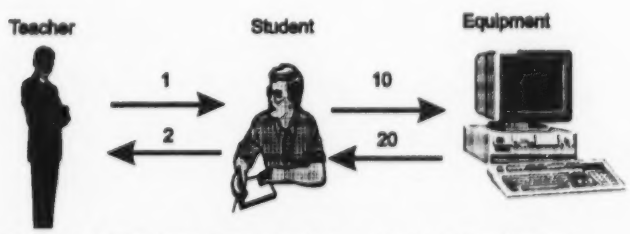
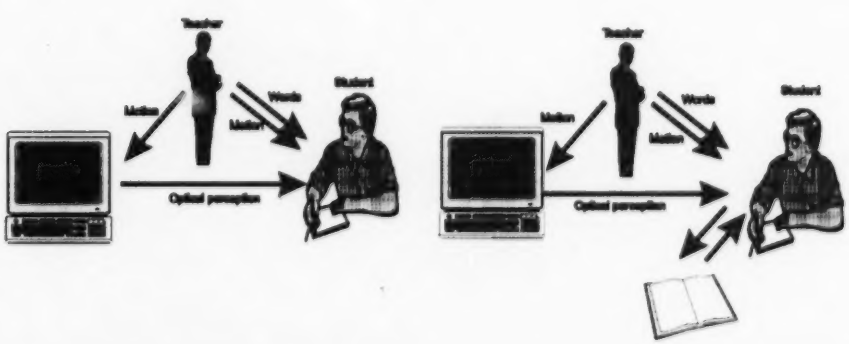


Fig. 4 Connections among teacher, student and equipment



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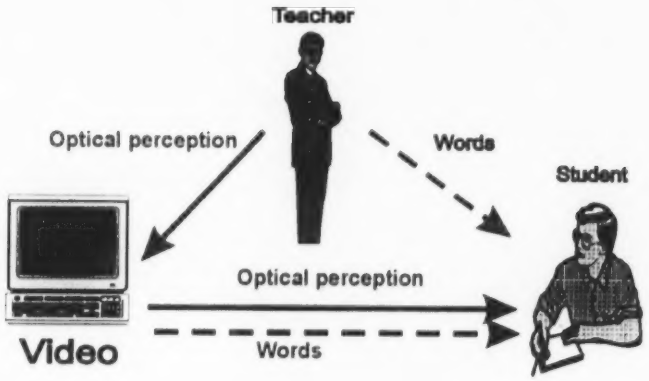

Fig.6 Utilization of video-programs, student as observer

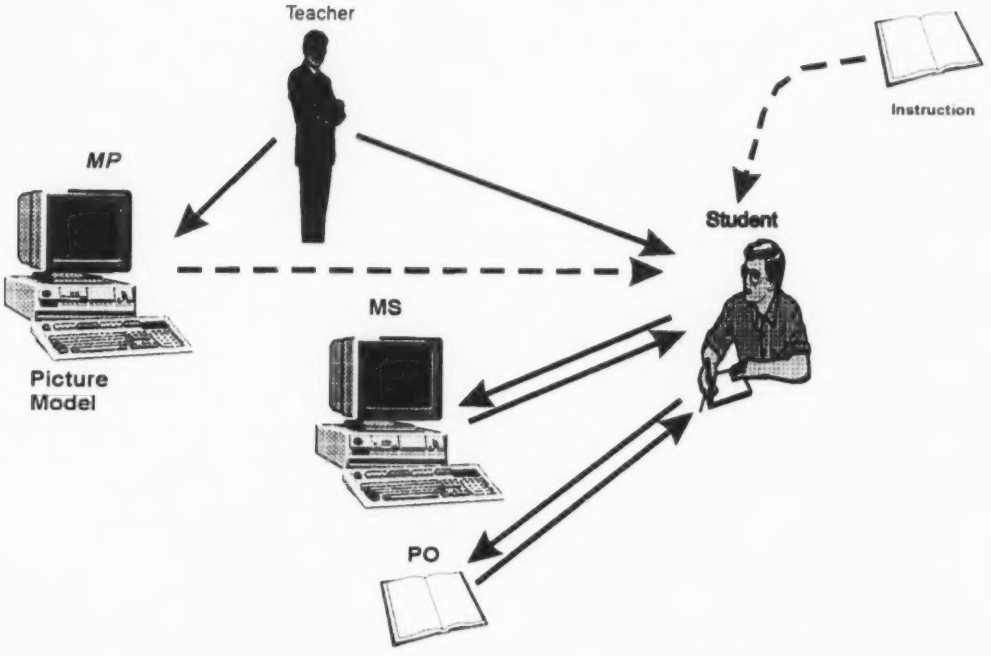

Fig.7 Utilization of computers by teacher and students during learning precess

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